XXXIX.—*The Copepod Fauna of the "Maare" of the Eifel.*
By Dr. JULIUS VOSSELER*.

SINCE Leydig's † investigations upon the fauna of the crater-lakes of the Eifel, the so-called "Maare," scarcely any naturalist has given any close attention to the lower animal world of those basins. Of the lower Crustacea only the Cladocera were investigated to some extent, while of the Copepoda only the occurrence of *Cyclops* in several lakes was mentioned. When in August of last year Dr. O. Zacharias ‡ undertook the study of the microfauna of these waters, which are interesting in many ways, I took upon myself the task of working up the Copepoda, and the more willingly as in so doing valuable information upon the distribution of species, the adaptability of the group under consideration, and various other interesting questions was to be expected.

As Dr. Zacharias was permitted to make his captures in part by means of a boat (on the Laacher See and Gemünder Maar), and, further, the pelagic fauna was pursued also at night, the following catalogue may furnish, at least for that time of the year, a tolerably complete picture of the distribution of the species and genera of Copepoda in the "Maare." The greatest number of species is harboured in the

I. LAACHER SEE.

By far the greater part of the Copepoda found here belong to the *littoral* fauna. Of Cyclopidæ the material placed at my disposal contained :—

1. *Cyclops viridis*, Fischer;
2. —— *tenuicornis*, Claus;
3. —— *signatus*, Koch;

and of these three large species *Cyclops viridis* was the most abundant. Most of the animals were adult, but ovisacs only occurred very rarely in the females. The most numerously represented was

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* Translated from the 'Archiv für Naturgeschichte,' Jahrg. 55, Bd. i. p. 117, Tafel vi.

† 'Verhandl. Ver. d. preuss. Rheinlande und Westfalen,' Jahrg. 37 (1881).

‡ See his "Bericht über eine zoolog. Exkursion an die Kraterseen der Eifel" (Biol. Centrallb. Bd. ix. 1889), to which this paper forms a supplement.

4. *Cyclops agilis*, Koch,

and that in all ages. A species very nearly allied to this, which, as an inhabitant of all the "Maare" examined, is characteristic of these waters, and which has not yet been described, I name

5. *Cyclops maarensis*, sp. n.

The thorax (embracing the first four segments) is elongate ovate. Its last (fourth) segment bears five hairs at the postero-lateral margin. The abdomen has a slender appearance owing to the delicate furca. The first antennæ are twelve-jointed and do not reach to the extremity of the long cephalothorax (first body-segment). In the first third of the fourth joint of these antennæ a strong seta is remarkable for its length. The last three joints gradually increase, but all three are of small size. The second antennæ are short and stumpy. The labrum is deeply incised in the middle and bears eight larger and four smaller teeth (the latter two on each outer side). The buccal organs are remarkable for their feeble development. The swimming-feet are long and bear at the tips of their branches stiff spines, resembling lance-heads serrated on both sides. The fourth pair of feet, when laid close to the body, reaches beyond the genital aperture. The last joint of the outer ramus bears three spines in the first pair of swimming-feet, four in the second, four in the third, and three in the fourth. The rudimentary foot consists of a single joint, with a strong spine on the inside, and furnished with a seta at the apex and on the outside. The last segment of the abdomen, which bears the furca, is finely hairy at the hinder margin; the preceding segments are toothed. This species is very easily recognizable by the furca, which is remarkably slender and longer than the three preceding abdominal segments. The external lateral seta is placed about the last (posterior) fourth of the length of the furca. Above it a half-circlet of small hairs winds spirally forward and outward. Of the terminal setæ I found only the two middle ones hairy. In the male these setæ are characterized by remarkable inflations in the first half. The adult female measures 1·8 millim. including the caudal setæ, the male 1·2 millim. The ovisacs are borne in the same way as in *C. agilis*.

This new species is distinguished from *C. agilis*, Koch, by absolutely and relatively shorter antennæ, fully developed buccal organs, and an extraordinarily elongated furca. While the latter in *C. agilis* is serrated at the outer margin, in *C.*

maarensis it bears above the outer lateral seta an obliquely placed half-circlet of fine hairs.

Besides these five Cyclopidæ, a Harpactide, namely

6. *Canthocamptus minutus*?, Müll.,

belongs to the littoral fauna. Of this Copepod I had only quite young specimens and the much injured body of a full-grown animal. I therefore do not venture to refer the animal in question with perfect certainty to *Canth. minutus.*

The *pelagic* fauna of Copepoda seems to be sharply separated from the littoral fauna, and is represented by two species, which, however, elsewhere scarcely ever wander from the shore in the larger basins, and still more seldom exclusively form the pelagic fauna, as here in the Laacher See. These are:—

7. *Cyclops strenuus*, Fisch., and
8. *Diaptomus cœruleus*, Fisch.,

the latter a pretty little variety about 1·8 millim. in length.

Although in number of species the Copepoda are abundantly represented, the number of individuals is too small for these Crustaceans to play an important part in the fauna of the Laacher See.

The examination of the material from the

II. GEMÜNDER MAAR

gave four Cyclopidæ, namely

1. *Cyclops strenuus*, Fisch. (pelagic),
2. —— *tenuicornis*, Claus,
3. —— *agilis*, Koch,
4. —— *maarensis*, sp. n.,

and the Calanid, now for the first time found in Germany,

5. *Diaptomus graciloides*, Lillj.

The first description of this species was given by Prof. Lilljeborg in the summer of last year *. It was, however, not very detailed nor illustrated with figures. In what follows I endeavour to fill up this deficiency to the best of my power, and in this I have been aided by the kindness of Prof. Jules Richard, of Paris, to whom I am indebted for correctly determined specimens of this species, which would be difficult to recognize from Lilljeborg's description.

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* Bull. Soc. Zool. France, tome xiii. p. 156.

The slender ovate thorax is not strikingly distinguished from the short abdomen. The lateral angles of the fourth segment are not produced. The first antennæ extend the whole length of the body and are very strongly constructed, by no means slender. Lilljeborg's statements as to the geniculate male antennæ, namely "articulus antepenultimus plane dearmatus," I do not find to be correct. In my investigations I always found seated upon the joint in question two setæ, one of which is very long.

The following numbers show the comparative lengths of the individual joints in the female antennæ :—

I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.
30.	25.	15.	12.	18.	18.	20.	18.	18.	18.	20.	13.	25.	15.	25.	25.	25.	28.	30.	25.	25.	30.	35.	33.	20.

The mandibles are armed with six distinct teeth, besides which there are towards the emargination some rudimentary ones. The inferior maxilliped is more stumpy than in *D. gracilis*, Sars. Its first joint has, on the anterior margin, four ridges, of which the first bears one seta. On the second there are two, on the third three, of which the middle one is the shortest, and on the fourth four setæ. One of the most important characters of this species, as in the other species of the genus *Diaptomus*, is furnished by the structure of the rudimentary pair of feet. The rudimentary foot of the female consists of a short basal joint upon which are seated a two-jointed outer and a one-jointed inner ramus. The first joint of the outer branch is long; the second cleft at the apex into two dissimilar parts. Of these the inner one forms a spine bent inwards; the tip of the other bears a short and a long seta, the latter extending as far as the end of the above-mentioned spine. Opposite the base of the spine on the outer side of the joint there is a fine setule. The inner ramus is longer than the first joint of the outer one and furnished at the end with two setæ of nearly equal length, besides which there is a smaller one seated more towards the inner side. The right rudimentary foot of the male consists of a basal joint which is but little longer than broad. The first joint of the outer ramus is short and produced into a small projection on the outer margin. The second joint is about as long as the basal joint. In the last quarter of it, on the outer margin, is seated a spine which is as long as the joint. At the apex is geniculated a spine formed by the transformation of the third joint of the ramus, which is at least as long as the three preceding joints. At its base it is dilated into a vesicular form, and about the middle it makes a bend, so that its two halves stand nearly at right angles to each other. The one-jointed inner ramus bears some fine hairs at the extremity. The left rudimentary foot of the male is a little shorter than the right one. The basal joint is larger than that of the right foot. The apex of the second joint is produced into a short stiff spine, close to which, on the inside, another more slender one is attached. In the small ovisac I always found only two eggs. The length of the female including the caudal setæ is 1 millim. and that of the male 0·8–0·9 millim., or rather less than found by Lilljeborg.

This species comes very near *Diaptomus gracilis*, Sars, and it is quite possible that it is only a form of that species produced by adaptation and isolation. I have obtained, also from Dr. Zacharias, an abundance of *Diaptomus gracilis* from the "Faulen See," near Frankfort on the Oder. Some of the specimens of normal size showed small variations which partly agree with the characters of *Diaptomus graciloides*. I hope shortly to be able to make a more exact investigation of these conditions, by which, perhaps, some light may be thrown upon the causes of the variations. *Diaptomus graciloides* was found by Lilljeborg chiefly in the great freshwater lakes of Sweden and the Russian Kola peninsula to near the shores of the northern icy sea.

Of all the species cited from the "Gemünder Maar" I obtained only very few sexually mature animals, and especially in the case of the *Diaptomus* I had much trouble in finding in the rich material a sufficient number of adult specimens for the investigation.

All the Copepoda were strongly coloured red, the *Diaptomus* most intensely. The colouring-matter was chiefly combined with fat and could be extracted with this by ether.

The group of the Copepoda inhabiting the

III. HOLZMAAR

is again differently constituted from that in the fauna of the two "Maare" described. There are still the three Cyclopidæ found in all the "Maare":—

1. *Cyclops tenuicornis*, Claus.
2. —— *agilis*, Koch.
3. —— *maarensis*, sp. n.

The Calanidæ are represented by

4. *Diaptomus castor*, Jurine.

In my Inaugural Dissertation *, like most of my predecessors, I identified *D. castor*, Jur., and *D. cæruleus*, Fisch. Mr. A. Poppe, of Vegesack, had the kindness to call my attention to my error and sent me examples of *Diaptomus castor* from which I was able to convince myself that the description in the above-mentioned memoir was founded upon *Diaptomus cæruleus*, Fisch., the two species being sharply distinguished from each other.

In the Maar last investigated, the

IV. PULVERMAAR,

there were only the three species of *Cyclops*:—

1. *Cyclops tenuicornis*, Claus.
2. —— *agilis*, Koch.
3. —— *maarensis*, sp. n.

Of the three genera of Copepoda which, according to the foregoing statements, occur in the "Maare," we find:—

1. *Cyclops*, with six species.
2. *Canthocamptus*, with one species.
3. *Diaptomus*, with three species.

The singular mode of occurrence of *Diaptomus cæruleus* and *D. castor* merits special mention. The former occurs usually in the larger accumulations of water. But hitherto I know of no case in which it belongs, as in the great "Laacher See," to the pelagic fauna, nay, so far as the Copepoda are concerned, forms this almost exclusively. *Diaptomus castor* which, from accordant statements, rather belongs to the smaller stagnant waters, ventures, however, in the "Holzmaar" into a comparatively large basin, while as regards the small *D. graciloides*, Lilljeborg's statements, according to which it particularly affects large pieces of water, are confirmed.

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* "Die freilebenden Copepoden Württembergs und angrenzender Gegenden" (Jahreshefte d. Vereins für vaterl. Naturkunde in Württemberg, 1886, p. 167).

As no doubt in most cases, all the waters in the district of the Eifel have probably been peopled with Copepoda by passive immigration. Moreover active immigration could only occur in those lakes which are connected with the river-system of the Moselle and Rhine, *e. g.* in the Laacher See. I think, however, that we may assume with good reason that the lake just mentioned owes its richness in species to the greater concourse of aquatic birds and insects induced by its more extensive surface. These, according to Migula's recent investigations *, evidently play a most important part in the peopling of closed basins with the lower animals. The completely closed Gemünder Maar obtained its Copepod fauna, which nevertheless is considerable, solely by such transportation.

From the results obtained it seems very desirable that those "Maare" which have not yet been investigated should be carefully studied. Those which have already been examined will also furnish much of interest to renewed investigation, perhaps at different seasons of the year. Even the remarkable circumstance that in most "Maare" at the season apparently most favourable for the reproduction of the Copepoda so few animals with mature sexual products were found is an inducement to further investigation.

On a Cyclops *with a defective Furca.*

In my repeated examination of the Copepod material from the Laacher See my attention was attracted by a specimen of *Cyclops agilis*, Koch, of which the furca was crippled in a remarkable manner. The right half of the furca is thinner and about one fifth shorter than the left half. Curiously enough the setæ are as strongly developed on the smaller member as on the normal one; only the outer apical seta is removed to the place which in the normal form is occupied by the outer lateral seta. The latter, in the right division of the furca, is seated nearly in the middle of the outer surface, and is therefore displaced towards the head. Further deviations from the normal structure are also shown by the last three abdominal segments, inasmuch as they do not lie straight behind one another, but form a slight curve towards the right.

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* 'Biologisches Centralblatt,' 1888, no. 17.

The last of them, which bears the furca, is also unsymmetrically developed. In correspondence with the relative sizes of the two halves of the furca, the left side of the segment in question is considerably broader than the right. The serration characteristic of the furca of this species terminates regularly on each side just above the lateral seta, but on the right side it commences, not as on the left immediately beneath the hinder margin of the last segment, but somewhat further back. This malformation may be original, but is more probably produced by a subsequent accident (perhaps in change of skin). In the reproduction of the lost part of the furca it was not again completed of the normal size; but in this way certainly the displacement of the above-mentioned seta is not easy to explain.

XL.—*Considerations on the Structure of Rhizopod Shells.*

By Friedrich Dreyer[*].

In the course of my investigations upon Rhizopoda, and especially upon the Radiolaria, various considerations of a general character have impressed themselves upon me. In part similar ideas have been already touched upon by previous authors and occur scattered in the most various parts of the copious literature; several points to be referred to in what follows I have already incorporated with the special investigations in the first part of my 'Radiolarienstudien'[†]; nevertheless I regard it as a not unprofitable task to reproduce in the following pages in a connected form the complete train of thought of my considerations upon the structure of the Rhizopod shells, as I hope that it will be of interest even for many who do not occupy themselves specially with the Protistan group in question.

Even on a superficial consideration of the enormous number of forms of the Rhizopoda we may recognize in them an essential difference in the general habit of the shell, and, in accordance therewith, distinguish two groups of forms. One

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[*] Translated from the 'Biologisches Centralblatt,' Bd. ix. pp. 333–352 (1st August, 1889).

[†] F. Dreyer, 'Morphologische Radiolarienstudien,' Heft I. "Die Pylombildungen in vergleichend-anatomischer und entwicklungsgeschichtlicher Beziehung bei Radiolarien und Protisten überhaupt, nebst System und Beschreibung neuer und der bis jetzt bekannten pylomatischen Spumellarien" (Jena, 1889).